

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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JUL 23 1992

Federal Communications Commission
Office of the Secretary

In the Matter of

Amendment of Section 90.239
of the Commission's Rules to
Adopt Permanent Regulations for
Automatic Vehicle Monitoring
Systems

RM No. 8013

To: The Commission

STATEMENT IN OPPOSITION TO PETITION FOR RULEMAKING

Pursuant to Section 1.405 of the Rules, 47 C.F.R. §1.405, the Association of American Railroads ("AAR") hereby comments on the above-captioned petition for rulemaking recently filed by North American Teletrac and Location Technologies, Inc. (hereafter "Teletrac").^{1/} Teletrac's petition addresses the rules governing automatic vehicle monitoring (AVM) systems. Because grant of Teletrac's petition could interfere with the development of AVM technology and hinder operation of the AVM marketplace, AAR strongly opposes Teletrac's petition.

AAR is a voluntary, non-profit organization composed of member railroad companies operating in the United States, Canada and Mexico. These railroad companies generate 97% of the total operating revenues of all railroads in the United States. The AAR is the joint representative and agent of these railroads in

^{1/} By Public Notice released June 23, 1992 (Report NO. 1897), the Commission invited interested persons to file statements opposing or supporting Teletrac's Petition for Rulemaking.

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connection with federal regulatory matters of common concern to the industry as a whole, including matters pertaining to regulation of communications. In addition, AAR functions as the frequency coordinator with respect to applications by the member railroads for licenses in the Private Land Mobile Radio Service.

As the Commission is aware, AAR and the U.S. rail industry have longstanding experience with the problem of locating and tracking vehicles. Although individually owned by any one of several railroad and private rail car companies, railroad rolling stock travels throughout North America, pulled by locomotives operated by any number of railroad organizations, on tracks owned by various companies. One of the most significant problems facing the railroads today is the efficient management of their rolling stock, which presupposes reliable methods of locating rail cars at all times. Given the increasingly competitive nature of the railroad industry in particular and the transportation marketplace in general, efficient use of these mobile resources is critical to safe and effective service to the public and to corporate profitability.

AAR and the North American railroads have tested and used many systems in an attempt to streamline locating rail cars. Initially, much promise was foreseen in "bar code" systems, and

for several years in the mid-1970s such systems were tried. Problems of reading in inclement weather, near continuous maintenance, and the limited amount of information that can be contained in bar code panels limited the effectiveness of these systems.

For these reasons, several years ago the railroads, through the AAR, turned to RF-based technology for the automatic monitoring of vehicles. The AAR has completed and the railroads are implementing an industry standard relating to automatic equipment identification (AEI) technology. (See attached AAR Standard S-918, effective March 1, 1992, revised as of May 1, 1992.) This standard contains detailed specifications relating to the use of AEI equipment and specifically requires operation in the 902-928 MHz spectrum. AAR Standard S-918 will be mandatory for all rail cars used in interchange service (i.e., virtually every railroad freight carrying car in the North America fleet) by 1995.

The AAR standard is compatible with the standards adopted by the International Standards Organization (ISO) for international intermodal shipping containers, the American National Standards Institute (ANSI) for U.S. intermodal shipping containers and the American Trucking Association (ATA) for over-the-road trucks. These compatible standards will result in a "seamless" system for tracking the movement of containers both internationally and

domestically, regardless of whether such containers move by ship, rail or truck. This will enable enormous efficiencies in the transportation marketplace by increasing the accuracy of lading tracking and by reducing costs through proper routing of freight and elimination of paperwork.

Many AAR members have begun implementing automatic equipment identification (AEI) applications to conform to the AAR standard. AAR acts as the central point for FCC licensing of these systems. Prior to initial licensing, AAR met with the Commission's Private Radio Bureau licensing staff to discuss the operation of AVM technology used by the railroads. Following the grant of initial licenses by the Commission and based on favorable results of operating the initial facilities, the railroads launched a comprehensive program of tagging the nationwide rail fleet and installing readers along tracks and in terminals. To date, the Commission has granted licenses to railroads for over 250 reader locations under Section 90.239 of the rules. In many locations, only one reader is deployed; in switching yards, ten or more often are used; and some installations involve six readers at a single location (three on each side of each track) to identify the rail car, its direction of travel and the two layers of cargo containers on the car in order to track the movement of containerized freight. By the time the railroads' AVM program is completed, there will be over 1.4 million rail vehicles equipped

with AEI tags and 3,000 to 5,000 readers along the thousands of miles of track and in terminals throughout the United States and Canada. Tags are being added at a rate of about 15,000 cars per month at the present time.

In view of AAR's experience in AVM and the plans of U.S. railroads to improve their operation through use of AVM technology, AAR was deeply disturbed by Teletrac's petition. As AAR reads Teletrac's request, the proposal would undermine the railroad industry's efforts in at least two important respects.

First, Teletrac's request would have the effect of freezing the development of AVM systems. When the rules were established in 1974, the Commission could not predict the direction AVM service would take. Thus, the agency wisely adopted flexible policies to accommodate multiple concepts and systems. The railroads and the AVM industry have been well served by such flexibility, as it has permitted development of various AVM technologies as demanded by the marketplace. Because AVM systems are still evolving, flexible rules that do not lock in any particular technology would continue to serve the public interest.

Second, the Teletrac petition would have the effect of granting exclusive future use of the 904-912 MHz and 918-926 MHz portions of the frequency spectrum to Teletrac and similar users. This exclusive grant of use to Teletrac would significantly

interfere with implementation of AEI technology by AAR's member railroads. This is especially unwarranted given that the AVM technology that AAR uses was specifically designed to operate in a shared spectrum environment. Because such AVM technology utilizes low power and relatively small amounts of spectrum, it presents a minimal threat of interference to other systems. Systems that have more difficulty sharing, as Teletrac's petition implies its system does, should not be rewarded with exclusive access to scarce radio frequency spectrum.

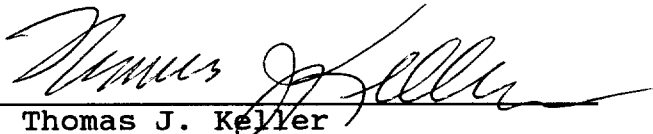
The national and international standards used by the railroads and other transportation industries were developed at significant cost (both in terms of money and effort) by the AAR, ATA and ISO, as well as the companies involved. The grant of exclusive spectrum use to Teletrac would clearly frustrate the efforts of the transportation industry to implement AEI applications that conform with these international and national standards.

In summary, access to the 902-928 MHz spectrum is required under the AAR standard and other standards applicable to the transportation industry. A grant to Teletrac of the exclusive use of this portion of radio frequency spectrum would potentially nullify these standards, to the detriment of the safe and efficient progress of rail transport.

Simply put, grant of Teletrac's request would dramatically narrow the amount of the 902-928 MHz spectrum available for railroad AEI applications and prohibit use of this technology in rail yards where more than two readers are required. AAR does not believe that this result would serve the public interest. Accordingly, AAR recommends that the Commission dismiss Teletrac's petition.

Respectfully submitted,

ASSOCIATION OF AMERICAN RAILROADS

By 
Thomas J. Keller

VERNER, LIIPFERT, BERNHARD,
McPHERSON AND HAND, CHARTERED
901 15th Street, N.W.
Suite 700
Washington, D.C. 20005
(202) 371-6060

Its Attorneys

July 23, 1992

Attachment: AAR Standard No. S-918

STANDARD S-918-91

STANDARD FOR AUTOMATIC EQUIPMENT IDENTIFICATION

Adopted 1991

Effective: March 1, 1992

Revised: May 1, 1992

1.0 GENERAL

1.1 Scope

This AAR Standard specifies requirements for the automatic electronic identification of equipment used in rail transportation, such as railcars, locomotives, intermodal vehicles and end-of-train devices (subsequently referred to as "equipment" in this document). The installation of this identification system on freight equipment is not a requirement for acceptance in railroad interchange service, except as specified in the AAR Field Manual of Interchange Rules.

This document describes a reflected energy system in which sensing equipment shall decode radio waves reflected by a tag mounted on equipment used in the transportation industry. The reflected radio waves shall indicate the identification code of the equipment as well as its related permanent information.

1.2 Field of Application

The identification system and data outputs described in this document shall be used to identify equipment by its individual alpha-numeric marking and other predefined information.

The system and data outputs described in this Standard are compatible with ANSI Standard MH5.1.9-1990 and ISO Standard 10374 for the automatic identification of containers. This Standard is also compatible with the standard of the American Trucking Associations (ATA) for automatic identification of trailers and chassis. The ATA standard also covers other highway equipment, such as tractors, straight trucks, and converter dollies. That standard is available from the ATA in Alexandria, VA.

1.3 References

1.3.1

American National Standards Institute, American National Standard for Freight Containers- Automatic Identification ANSI MH5.1.9-1990

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1.3.2

International Standards Organization, ISO 6346 - Freight Containers-Coding, Identification and Marking

1.3.3

International Standards Organization, ISO IS 10374 - Standard for Automatic Identification of Containers

1.3.4

Field Manual of the AAR Interchange Rules

1.3.5

AAR Manual of Standards and Recommended Practices, Section C, Part III- Specifications for Tank Cars (M-1002); Section L, Standard 910, Lettering and Marking of Cars

1.3.6

AAR Universal Machine Language Equipment Register [UMLER] Data Specification Manual

1.3.7

AAR TOFC/COFC Interchange Rule 173 [1989]

1.3.8

AAR Trailer and Container Service Rules, Section 3, Reporting Marks and Numbering System

1.3.9

Military Standard 810-D, Environmental Test Methods and Engineering Guidelines

1.3.10

International Standards Organization, ISO9001 - Quality Systems

1.3.11

AAR Specification M-1003, Specification for Quality Assurance

1.3.12

AAR Standard S-917-92, Specification for Application of Automatic Equipment Identification Transponders on Freight Cars.

2.0 IDENTIFICATION SYSTEM REQUIREMENTS

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2.1 General Requirements

For automatic identification purposes, each unit of equipment shall be fitted with a small tag (tag) containing the alphanumeric code of the equipment and related information. This code shall be read by an interrogator (reader) which operates on ultra high frequency radio waves. The interrogation unit shall decode the altered radio waves reflected by the tag on the equipment. The altered radio waves (modulation) shall indicate the alphanumeric identification code of the equipment as well as other predefined information.

The interrogator shall optionally add its own identification number, the date and time, and shall transmit all of this data over the user's communications link used for sending such messages. The transmission line interface shall be specified by the user.

The system shall be expected to accurately read freight trains moving at up to 80 mph, with any equipment configuration [e.g. double stack containers, including 20 foot units; containers on chassis on flatcars; end-of-train devices]. This requirement applies in areas of one, two, and more than two parallel tracks, at ordinary track centers, with trains standing or operating on any or all of these tracks, in the same or opposite direction.

2.2 Tag Requirements

2.2.1

Tags must be approved in accordance with Section 10.0 of this Standard and S-060, Application for Component Approval Procedures. Tags must meet the following requirements:

2.2.1.1

The tag unit shall be tamperproof and sealed such that it will survive and operate properly under the conditions of its expected operating environment. Tag life shall not be less than 15 years [may be less for intermodal tags], and no maintenance shall be required. The tag must meet appropriate test standards for long-term physical, radio frequency, thermal, and ultra-violet exposure.

2.2.1.2

The tags shall be designed to operate properly within the temperature range of -50 degrees C to +85 degrees C. They must maintain the integrity of stored data at temperatures of -60 degrees C to +85 degrees C. Some tags will be required to survive special operating environments, such as coal thaw sheds [per Military Standard 810D, Low Temperature and High Temperature].

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2.2.1.3

Tags shall not be damaged by the normal operation of shipborne radar or other electromagnetic sources normally found in or near railroad facilities. They shall be capable of full operation in the electromagnetic environment normally found at railroad facilities.

2.2.1.4

Tags shall survive and operate through the contaminants, shock and vibration experienced in rail service and highway and maritime service for intermodal tags. The tags shall meet or exceed the current version of the following environmental standards.

2.2.1.4.1

Low Temperature Mil. Std. 810D Method 502.2; minimum temperature of -50 degrees C

2.2.1.4.2

High Temperature Mil. Std. 810D Method 501.2 Procedure II; cycled between +70 and +38 degrees C

2.2.1.4.3

Mechanical Shock Mil Std. 810D Method 615.3 Procedure I; 30g for 11 milliseconds, half sine pulse

2.2.1.4.4

Random Vibration
With Temperature Mil. Std. 810D Method 520.0, Procedure II;
Two hour duration/axis up to 3g at -50 degrees C, ambient, and +70 degrees C ambient

2.2.1.4.5

Humidity Mil. Std. 810D, Method 507.2; 95% non-condensing

2.2.1.4.6

Rain Mil. Std. 810D, Method 506.1, Procedure II

2.2.1.4.7

Salt Fog Mil. Std. 810D Method 509.2, Procedure I

2.2.1.4.8

Drop Shock Mil. Std. 810D Method 516.3, Procedure II; height 3.3 meters, impact surface 5 cm plywood backed by concrete

Additional requirements [Military Standard 810D]:

2.2.1.4.9

Leakage [Immersion]

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2.2.1.4.10

Icing/Freezing Rain

2.2.1.4.11

Sand and Dust

Tags shall be capable of being programmed in the railroad environment by user personnel.

2.2.1.5 Marking

The designation "AAR," the type of tag, such as "AAR HIGH TEMP" or "AAR STANDARD" and the specific model and version number and lot number or Julian date shall be indelibly marked on the front face of the tag. These markings shall be readily visible when the tag is in place on the equipment.

Examples are as follows:

AT5110-AAR V1.00 w10
(Model No.) (Version No.) (Warranty Period in Years)

Standard Tag L91121
(Type) (Lot Number is Julian date tag passed final inspection)

AT5125-AAR V1.00 w10
(Model No.) (Version No.) (Warranty Period in Years)

High Temp Tag L91121
(Type) (Lot Number is Julian Date tag passed final inspection)

3.0 INTERROGATOR REQUIREMENTS

3.1

No minimum or maximum interrogator power shall herein be specified. However, the minimum antenna EIRP (effective isotropic radiated power) and interrogator receiver sensitivity shall be adequate to properly interrogate tags capable of responding as specified in this document at all distances between the minimum and maximum distances specified by the user. The maximum EIRP and transmitter power output of the interrogator shall be within the limits prescribed by the telecommunications authority of the country in which the interrogator shall be operated.

3.2

Interrogator units shall be capable of interrogating multiple tags within their reading field, discriminating between the tags without misreading. Interrogators employing tag response levels as a method of discriminating between multiple tags may accomplish this by distance differential and/or position relative to the antenna pattern.

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Error detection shall be used to ensure reading accuracy.

The interrogator system must accommodate both fixed and mobile vehicle applications.

3.3 Supplementary Interrogator Specifications

While not a part of automatic equipment identification per se, the following requirements are included because they are essential to railroads' effective utilization of AEI.

The system shall detect the presence and direction of movement of each individual unit of rolling stock and shall provide suitable output words for missing and incorrect tags (and incorrect characters if appropriate checking is implemented). The equipment detector function shall provide for sensing the following conditions:

3.3.1

Equipment presence - to detect each unit of rail rolling stock, whether equipped with a tag or not, including cars, locomotives and cabooses.

3.3.2

Train presence - upon approach of a train or a cut of cars or a single car, the system shall transition from the idle to the active mode. Upon the train or car(s) leaving the system, the system shall provide a "clean list" report on the net movement of equipment and the system shall transition to the idle mode. This "clean list" will contain no duplications or omissions of rolling stock initials and numbers due to stops and reverse moves before the interrogator.

The equipment detector function may be provided as part of an interrogator module or as a separate module. When provided as a separate module, the equipment detector function may be furnished by the railroad (in the form of track circuits or axle counters) rather than by the AEI vendor. The AEI vendor is not relieved of the AEI system performance responsibility in any case.

This document does not specify all attributes of the interrogator, as they are at the discretion of the user railroad.

4.0 SYSTEM OPERATION

4.1

The radio communication system described herein consists of a Reader System (i.e., Reader, RF Module, and Antenna) and Tags. Tags are placed on objects to be identified, and Readers, Antennas, and RF Modules are installed at points to record the passing of tagged objects. The system is designed for localized application where the Tag passes by the Reader system.

4.2

The block diagram of Figure 1 indicates the function of each component. The RF Module transmits an unmodulated signal in the direction of a Tag (f_o). The Tag reflects a modulated signal back to the RF Module (f_m). The RF Module receives the reflected signal from the Tag and relays this information to the Reader. The Reader decodes the information contained in the Tag and relays the information to a host computer for subsequent use to identify, track and schedule the tagged objects.

4.3

The Tag shall not be a transmitter and shall not contain components to generate Radio Frequency (RF) signals. The Tags must act merely as field disturbance devices, slightly modifying and reflecting the signal transmitted by the Reader System. This slight modification of the signal includes the unique identification code of the Tag. This method of communication is called "modulated backscatter".

4.4 RF Module

4.4.1

The RF Module shall be composed of an RF Oscillator, RF Processor, Receiver, and Preamplifier. The RF Module is responsible for transmitting and receiving radio energy. RF energy is generated by the RF Oscillator and amplified by the RF Processor. This energy is transmitted through the Antenna, and the RF energy reflected by the Tag is also received by the same Antenna.

4.2

The RF Module shall transmit a single frequency of RF energy and receive that same frequency after it is reflected from the tag.

4.4.3

The Receiver is used to separate the transmitted Continuous Wave (CW) energy from the information reflected by the Tag. The Tag information shall be encoded into 20 and 40 kHz signals which modulate the RF energy reflected by the Tag. The RF Module shall have the following approximate specifications:

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Description Typical Specifications

Nominal RF power (measured at transmitter)	2.0 Watts
Standard transmit and receive frequency	912 MHz
Other reader frequencies available by special order	904 to 912 and 918 to 928 MHz
Frequency stability	0.0005 percent
Harmonic output	-50 dBc
Spurious output	-60 dBc
Transmitter Bandwidth	5 kHz
Receiver Bandwidth	130 kHz
Frequency separation for multiple Reader Systems ¹	2 MHz

4.5 Reader

The RF Module receives the modulated signal from the Tag and passes the 20 and 40 kHz modulating frequencies to the Reader. The Reader shall decode the frequencies into binary information equivalent to the 128 bits of data stored in the Tag. The Reader is composed of the Amplifier, Decoding and Error Checking circuit, Microprocessor, Real-Time Clock circuit, and Power Supply.

4.6 Antenna

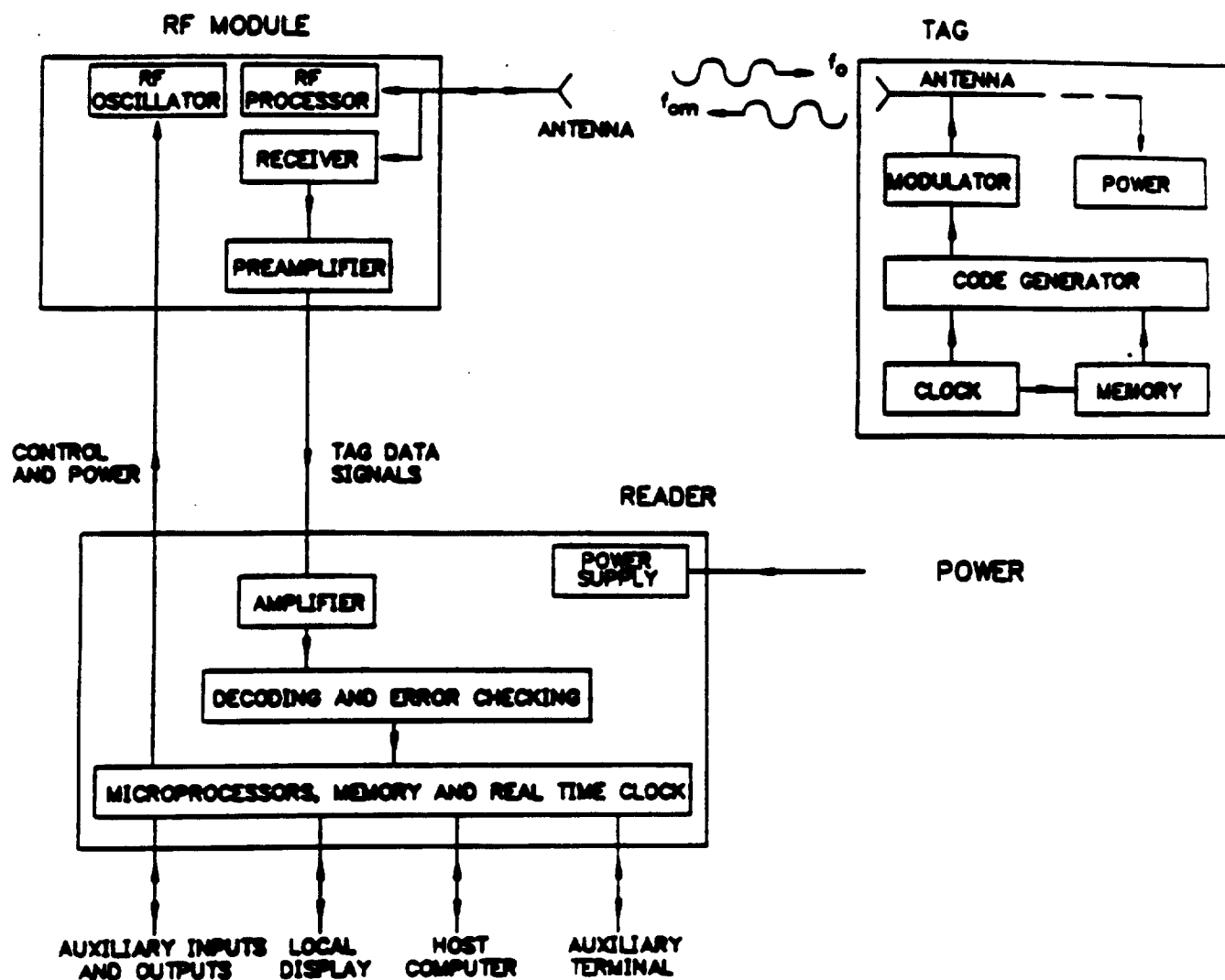
The Reader System shall be capable of using a single Antenna to transmit and receive RF energy.

4.7 Tag

4.7.1

The Tag shall be composed of the Modulator, Power, Code Generator, Clock, Memory, and Antenna circuits. The Clock circuit sequences all circuit functions such that information stored in the Memory circuit is conveyed to the Reader System within precise timing. The information stored in the Memory circuit is permanent, and is a unique code which is specified by the owner prior to installation of the Tag onto its respective object (container, rail car, truck, etc.).

¹Some installations require a number of Reader Systems to operate in close proximity, i.e., less than 100 meters between Reader Systems. These RF Modules must operate at frequencies separated by a minimum of 2 MHz.



Block Diagram of the RF Module, Reader, Antenna and Tag
Figure 1

4.7.2

The Code Generator encodes the information stored in the Memory circuit. The Modulator collects the encoded information from the Code Generator and controls the Antenna circuit such that the encoded information is reflected to the Reader System.

4.7.3

There may be two versions of the Tag; battery-powered and non-battery-powered. The non-battery Tag must be sufficiently close to the Reader System's Antenna in order to collect enough energy to activate the Tag's electronics. The battery-powered Tag does not require as close proximity to the Reader System's Antenna since the battery activates the electronics at all times. Advantages of the battery Tag shall include greater range and reduced RF power required from the Reader System, and the advantage of the non-battery Tag shall be an extended life. Regardless of whether the Tag has a battery or not, a Tag does not transmit RF energy; it only reflects energy transmitted by the Reader System.

5.0 TAG TO SENSING EQUIPMENT COMMUNICATION

5.1

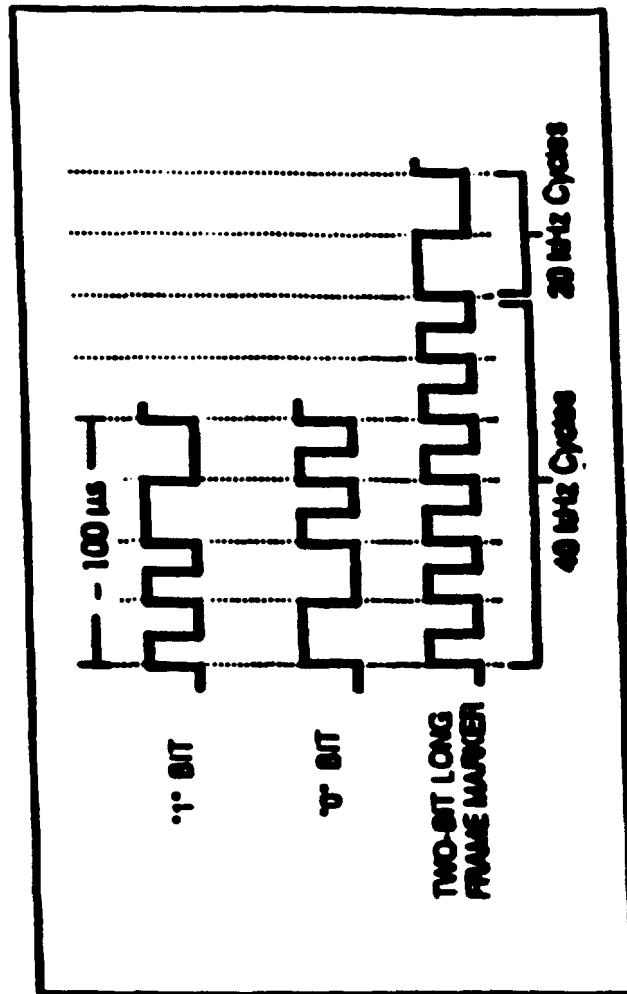
The encoding of user data bits shall include 8 sub-bits for each user bit. A sub-bit shall be coded by the Tag and decoded by the sensing equipment with a modified FSK (frequency shift keying) code using two harmonically related frequencies, one (40 kHz.) being the exact double of the other (20 kHz.), with a frequency tolerance of $\pm 10\%$. A '0' bit shall consist of one 20 kHz square wave cycle followed by two 40 kHz square wave cycles. A '1' bit shall consist of two 40 kHz square wave cycles followed by a 20 kHz square wave cycle. All transitions shall be phase-continuous. As depicted in Figure 2, the tag shall produce a waveform which shall have a nominal 1 microsecond rise and fall time and duty cycle for the 20 and 40 kHz square wave cycles of 50%.

5.2

The tag electronics shall cause the data to scroll repeatedly without pause from bit "cell" 127 of a frame (a frame consisting of all 128 bits) to bit "cell" 0 of the succeeding frame.

5.3

The tag shall use the coded identification data and related permanent information to amplitude-modulate the incoming continuous wave radio frequency carrier signal from the sensing equipment. The resulting modified FSK signal (carrier and sidebands) shall be reflected by the tag, received by the sensing equipment for decoding, and after decoding made available to automatic data processing systems. The modulation polarity shall be of no consequence.



Frequency-Shift Keying (FSK) Encoding
Figure 2

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6.0 TAG FREQUENCY OF OPERATION AND SENSITIVITY

6.1 Tag Activation Thresholds

The non-battery tag shall not operate in RMS (root mean square) electric field strengths below 2.0 V/m, and shall operate properly in RMS electric field strengths above 3.5 V/m. The field strength required for non-battery tag operation shall not increase by more than 3 dB when it is rotated by ± 25 degrees in any plane.

A battery tag shall have a minimum sensitivity such that an interrogating signal of 150 millivolts per meter will allow proper tag operation.

Tags shall be operational within four milliseconds of excitation by an interrogating signal from the sensing equipment.

6.2 Tag Survivability

The tags shall survive and maintain the integrity of stored data in a maximum peak field strength of 50 V/m for 60 seconds, as may be encountered from any radio frequency source such as voice communications equipment.

6.3 Tag Performance Levels

When a properly presented tag is excited as indicated by an incident wave at a given reference range, it shall respond within the following modulated return signal strength, exclusive of carrier and as measured at the same reference range:

Tag Type	Frequency (MHz)	Reference Range	Test Conditions	RMS Signal Strength Microvolts/m	
				<u>Minimum</u>	<u>Maximum</u>
Beam (Non-Battery)	904-928	5m	3.5V/m at Tag	19,600	56,800
Battery	904-928	10m	EIRP = 1W	1,400	4,100

The battery tag's return signal strength shall be reduced by no more than 3 dB when the tag is rotated by ± 10 degrees in the plane coincident to the antenna polarization (horizontal for railcars, locomotives, chassis, and end-of-train devices; vertical for trailer and container tags), or rotated by ± 20 degrees in the plane perpendicular to the antenna polarization.

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7.0 TAG DATA CONTENT AND FORMAT

7.1

The Tag is composed of 128 bits of non-volatile memory which can be divided into two sections. The first section is composed of data bits which are used for procedural needs and the second section is composed of data bits which are available for general use (General Use area). Procedural needs include error checking, detecting a 128 bit frame of data, indicating the type of data format utilized in the tag, and providing security from unauthorized duplication of Tags. Twenty-six bits are used for procedural needs and 102 bits are available for general use.

7.2 Bits Reserved for Procedural Needs

A listing of the fields reserved for procedural needs is presented below:

Table A: Allocation of Fields Required for Procedural Needs

Field Designation	Bit Position (out of a possible 0 to 127)
First Check Sum	60, 61
Reserved Frame Marker	62, 63
Security	106-117
Format Code	118-123
Second Check Sum	124, 125
Frame Marker	126, 127

7.2.1 First Check Sum

There are three methods of error detection which are derived exclusively from the Tag data and the way it is conveyed to the Reader. The Check Sum fields are used in one of the methods to detect errors in the data received by the Reader. The First Check Sum is calculated by adding bits 0 through 59 and truncating all but the right-most two bits of the binary resultant. This calculation is done automatically by the Tag Programmer at the instant the Tag is programmed. When the Reader acquires Tag information, it checks these two bits to help determine if there is an error in the previous 60 bits.

7.2.2 Reserved Frame Marker

Reserved for future use as a Frame Marker.

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7.2.3 Security

These 12 bits have been reserved for Security purposes, although if Security is not desired, these bits can be designated for limited general use. The Security field has been divided into two six-bit fields. For Security applications, the two fields may contain any combination of the values presented in Table B or one field must contain a Security value and the other field may contain any value in Tables B or C. If an owner requires security, a unique security character will be assigned to the owner's Tag Programmer at the time of purchase or the security field can be programmed at the factory.

Table B: Reserved Security Values

Six-Bit ASCII Character	Decimal Value	Six-Bit ASCII Character	Decimal Value	Six-Bit ASCII Character	Decimal Value
!	1)	9	?	31
"	2	+	11	@	32
#	3	,	12	[59
\$	4	:	26	\	60
%	5	;	27]	61
&	6	<	28	^	62
'	7	=	29	_(underline)	63
(8	>	30		

If the user does not require Security then the two fields can contain any combination of the following values:

Table C: Non-Secure Data Values

Six-Bit ASCII Character	Decimal Value	Six-Bit ASCII Character	Decimal Value	Six-Bit ASCII Character	Decimal Value
(space)	0	9	25	N	46
*	10	A	33	O	47
-	13	B	34	P	48
.	14	C	35	Q	49
/	15	D	36	R	50
0	16	E	37	S	51
1	17	F	38	T	52
2	18	G	39	U	53
3	19	H	40	V	54
4	20	I	41	W	55
5	21	J	42	X	56
6	22	K	43	Y	57
7	23	L	44	Z	58
8	24	M	45		

7.2.4 Format Code

The format code indicates the type of coding scheme utilized for the bits defined for general use. The following binary format codes (most significant bit on the left) have been assigned:

000000: Indicates 6-bit ASCII format. This format partitions the General Use area into contiguous six-bit fields into which any character indicated in Tables B or C above can be programmed.

110011: This data format is defined by the International Standards Organization Standard 10374 and IS 10374 Addendum 1 and the Association of American Railroads Standard. These standards guarantee that the Data Format, Tag type, Check Sums, Frame Markers, Equipment Group Code and Security fields will be fixed for all types of referenced equipment and will be uniformly positioned and defined. Other fields such as the Owner's Code, and Length may expand, contract, or change definition from one type of equipment to the next.

110100: This value indicates a Tag programmed for toll road use.

There are a total of 61 additional values which have not been assigned and are reserved for future use. Throughout this document, the term "reserved" implies that the value should not be assigned by the User or Owner for his own purposes; the value may be assigned by the AAR, a standards organization or some other regulatory group.

7.2.5 Second Check Sum

Similar function and method of calculation as the First Check Sum except that it is used to help verify the data integrity of Tag bits 62 to 123.

7.2.6 Frame Marker

These two bits contain a special unique signature which is neither a one or a zero, and is used to indicate the start of the next frame.

7.3 General Use Fields

The allocation and definition of Tag data bits available for general use are specified in the following appendices:

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- Appendix A - Railcar**
- Appendix B - Locomotive**
- Appendix C - Trailer**
- Appendix D - Chassis**
- Appendix E - End-of-Train Device**
- Appendix F - Intermodal Container**

7.3.1 Physical Measurements

All physical measurements (such as length, height, weight, etc.) specified in Appendix A through F shall be integer numbers. Fractional measurements shall be rounded to next higher integer. Unless otherwise specified, data elements are defined as specified in the AAR Universal Machine Language Equipment Register [UMLER] Data Specification Manual.

Measurements shall be encoded into tags in metric units, and the metric value will be stored in the tag. When tag information is sent from the reader to a host computer, either the metric value or English equivalent, depending on the user's preference, will be output.

7.3.2 Equipment Initial/Owner Code and Number

Trailing blanks shall be employed on the Equipment Initial/Owner alpha code, and leading zeros shall be used on the numeric identification field.

8.0 TAG ENCODING EQUIPMENT AND PROCEDURE

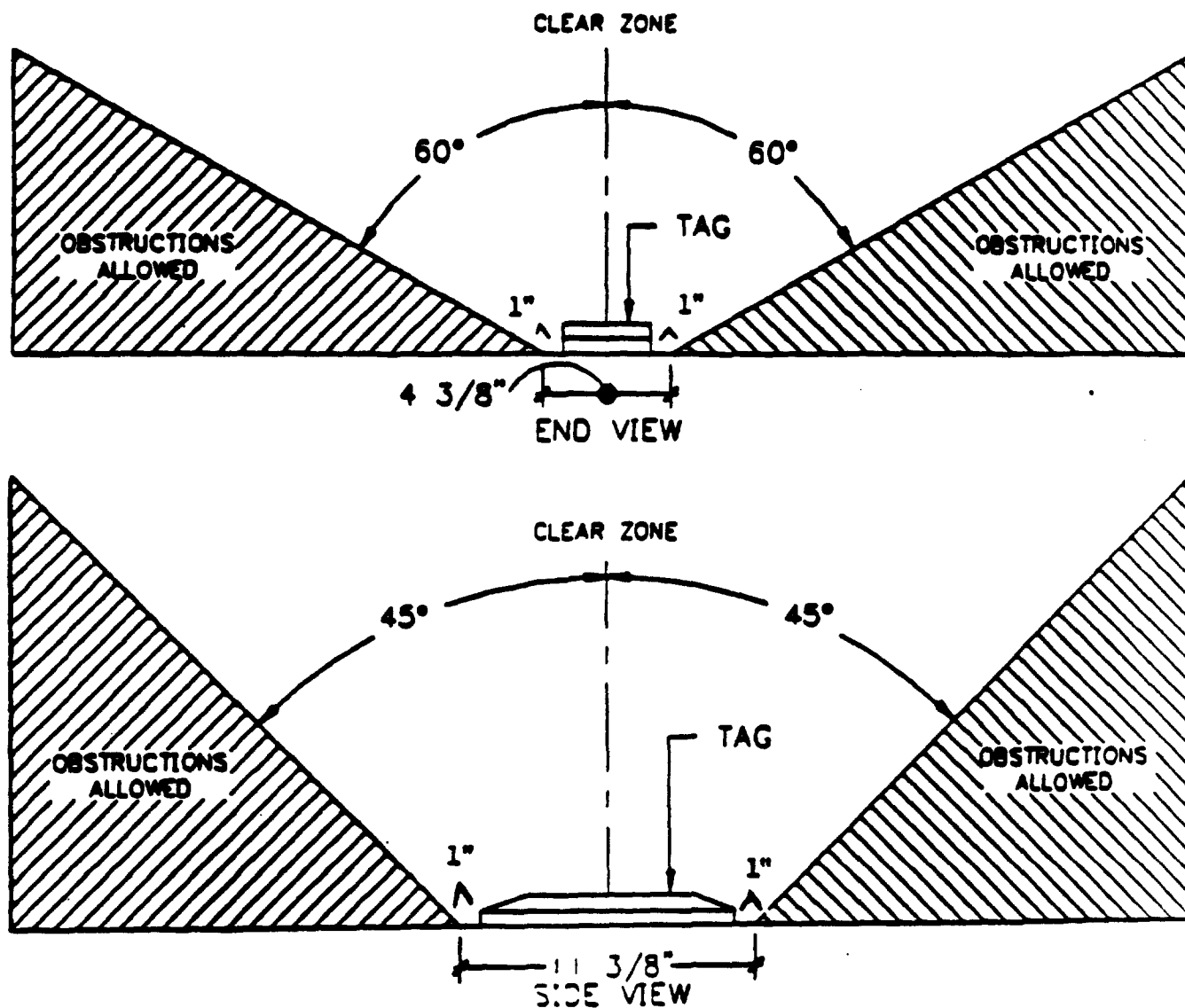
Tags must be capable of encoding both by the vendor and by railroad personnel at railroad facilities. Procedures for encoding tags are to be provided by their vendors.

9.0 LOCATION AND MOUNTING OF TAGS ON EQUIPMENT

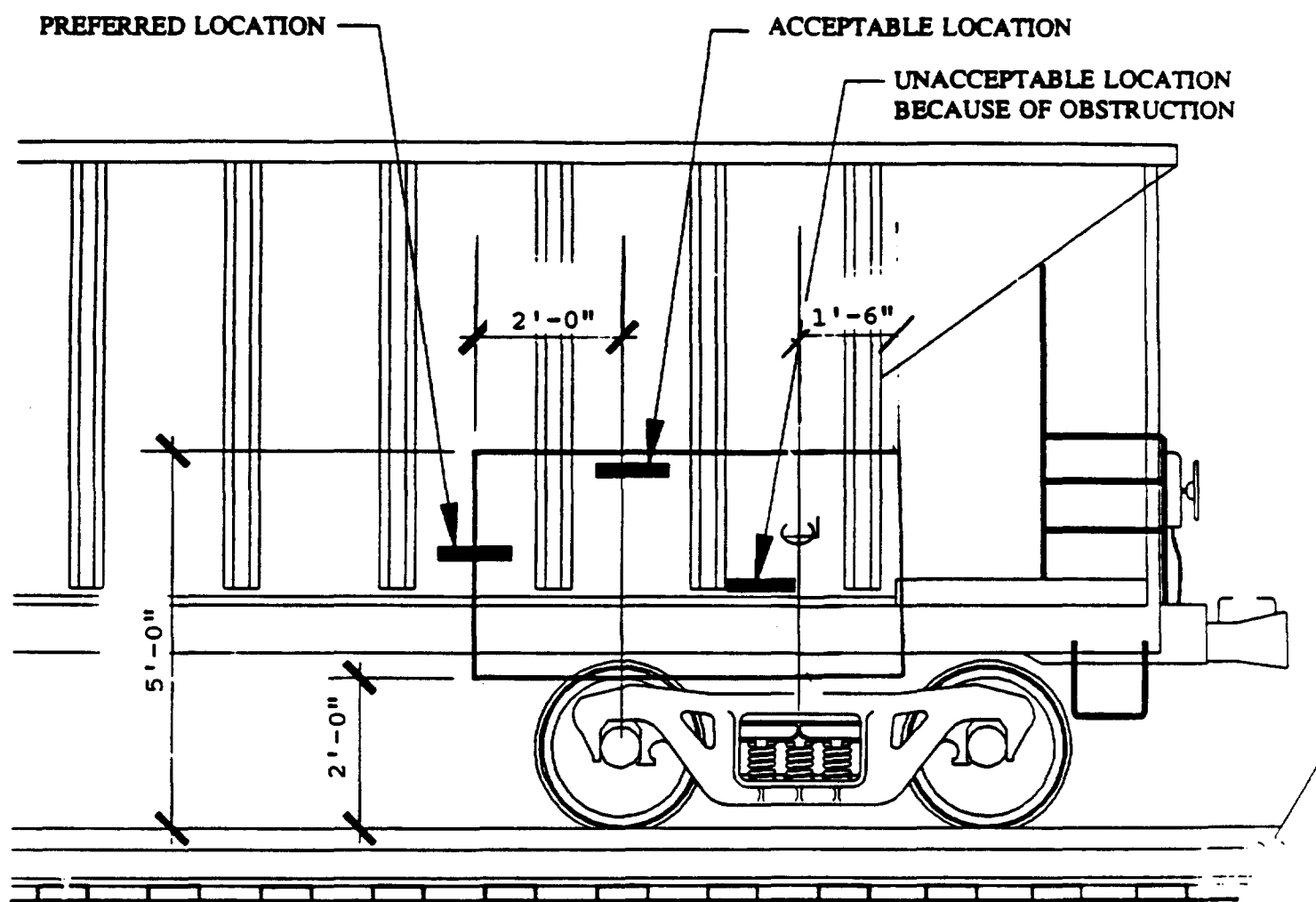
9.1 General Mounting Specifications - All Equipment

The mounting surface must be metal, vertical and smooth within the area of the tag. No area on the tag's rear surface may be more than 1/4" from the metal mounting surface. Mounting surface must not require bending of the tag during attachment. In case the desired mounting area will not meet this requirement, a mounting bracket must be provided to satisfy this requirement.

Association of American Railroads
Mechanical Division
S-918 Manual of Standards and Recommended Practices



Tag Mounting Clearance Zone
Figure 3



MOUNTING LOCATION EXAMPLES

Figure 4